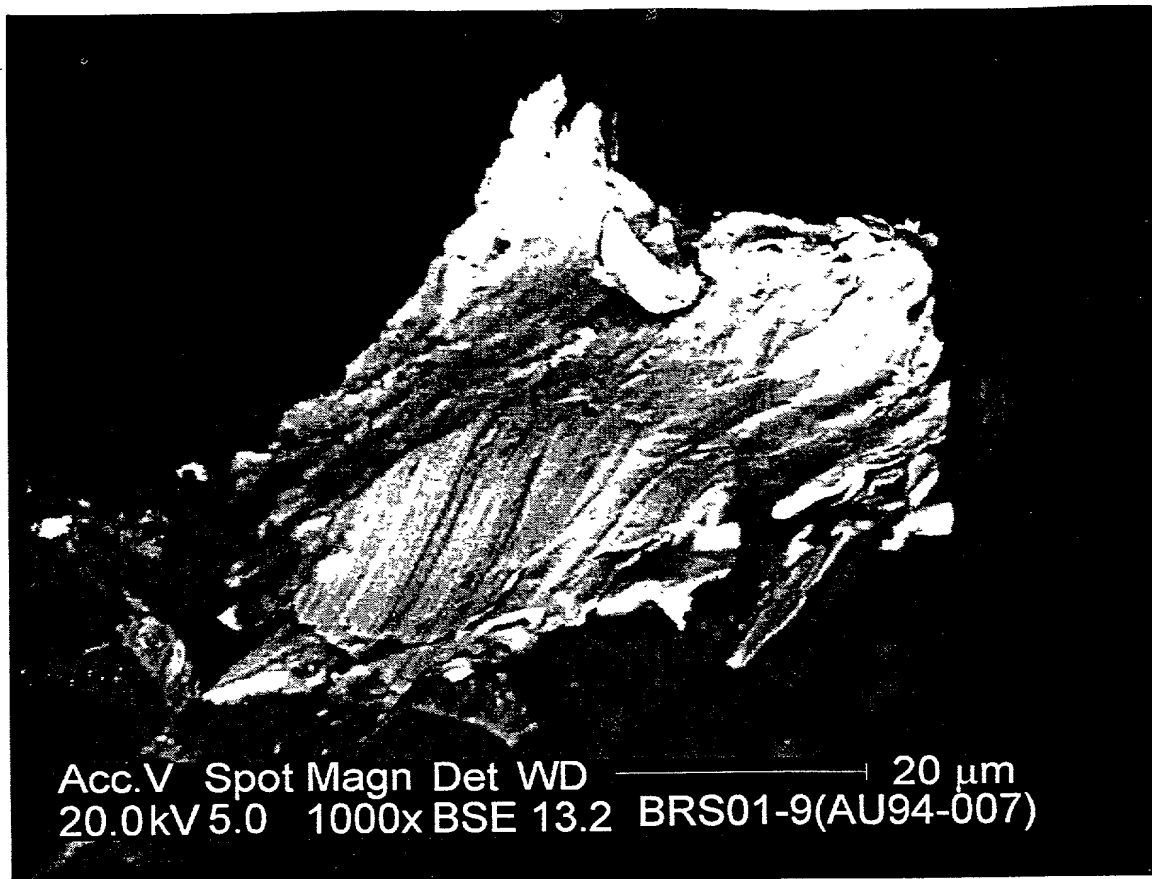


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FIGURE 3. A schematic flowsheet of the various aspects of the invention.

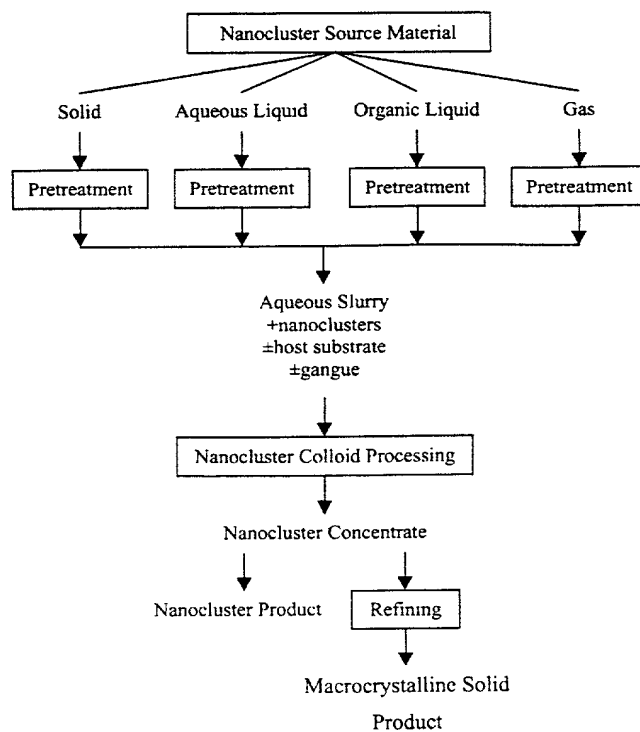


Figure 4. A flow process diagram of pretreatment processes, in accordance with the invention. Explanation: horizontal arrows indicate process; **OP** indicates optional process; underlined indicates material or process product; a downward pointing vertical arrow indicates process products that are advanced to subsequent processing step.

- 4A. SOLID NANOCLUSTER SOURCE MATERIAL
 → **OP: PREVENT FROM DRYING**
 → **CRUSH**
 → **MILLING**
 ↓ NANOCLUSTERS + HOST SUBSTRATE + GANGUE ± WATER
 → **SLURRY**
 ⇒ **TO NANOCLUSTER COLLOID PROCESSING**
- 4B. AQUEOUS LIQUID NANOCLUSTER SOURCE MATERIAL
 → **OP: PREVENT FROM DRYING**
 ⇒ **OP: TO NANOCLUSTER COLLOID PROCESSING**
 → **PHASE SEPARATION**
 • WATER: to water treatment or recycle
 ↓ NANOCLUSTERS ± HOST-SUBSTRATE ± GANGUE
 → **SLURRY**
 ⇒ **TO NANOCLUSTER COLLOID PROCESSING**

Figure 4. Continued.

4C. ORGANIC LIQUID NANOCLUSTER SOURCE MATERIAL

→ OP: PREVENT FROM DRYING

→ PHASE SEPARATION

- WATER: to aqueous liquid pretreatment, water treatment or recycle

↓ ORGANIC LIQUID + NANOCLUSTERS ± HOST-SUBSTRATE

→ PHASE SEPARATION

- ORGANIC LIQUID: to hydrocarbon processing

↓ NANOCLUSTERS ± HOST-SUBSTRATE ± GANGUE

→ SLURRY

⇒ TO NANOCLUSTER COLLOID PROCESSING

4D. GASEOUS NANOCLUSTER SOURCE MATERIAL

→ CONDENSOR

→ SCRUBBER(S)

- GAS: to gas processing

↓ WATER + NANOCLUSTERS ± HOST-SUBSTRATE

⇒ OP: TO NANOCLUSTER COLLOID PROCESSING

→ PHASE SEPARATION

- WATER: to water treatment or recycle

↓ NANOCLUSTERS ± HOST-SUBSTRATE

→ SLURRY

⇒ TO NANOCLUSTER COLLOID PROCESSING

Figure 5. A flow process diagram for nanocluster colloid processing, in accordance with an embodiment of the invention.

- NANOCLUSTERS ± HOST SUBSTRATE ± GANGUE ± WATER (from pretreatment)
 - OP: SLURRY CONDITIONING
 - OP: PHASE SEPARATION
 - WATER: to water treatment or recycle
 - ↓ ORGANIC LIQUID + NANOCLUSTERS ± HOST-SUBSTRATE
 - COLLOID REGENERATION
 - GEL HYDRATION
 - COLLOID PEPTIZATION
 - OP: HEAT & PRESSURE TREATMENT
 - DISPERSION
 - NANOCLUSTER COLLOID DESORPTION
 - PHASE SEPARATION
 - DEPLETED HOST SUBSTRATE + GANGUE: to recycle or tailings
 - ↓ AQUEOUS NANOCLUSTER COLLOID SOLUTION
 - NANOCLUSTER COLLOID RECOVERY
 - PHASE SEPARATION, or
 - ADSORPTION
 - WATER: to water treatment or recycle
 - ↓ NANOCLUSTER CONCENTRATE
 - OP: REFINE
 - ↓ MACROCRYSTALLINE SOLID PRODUCT

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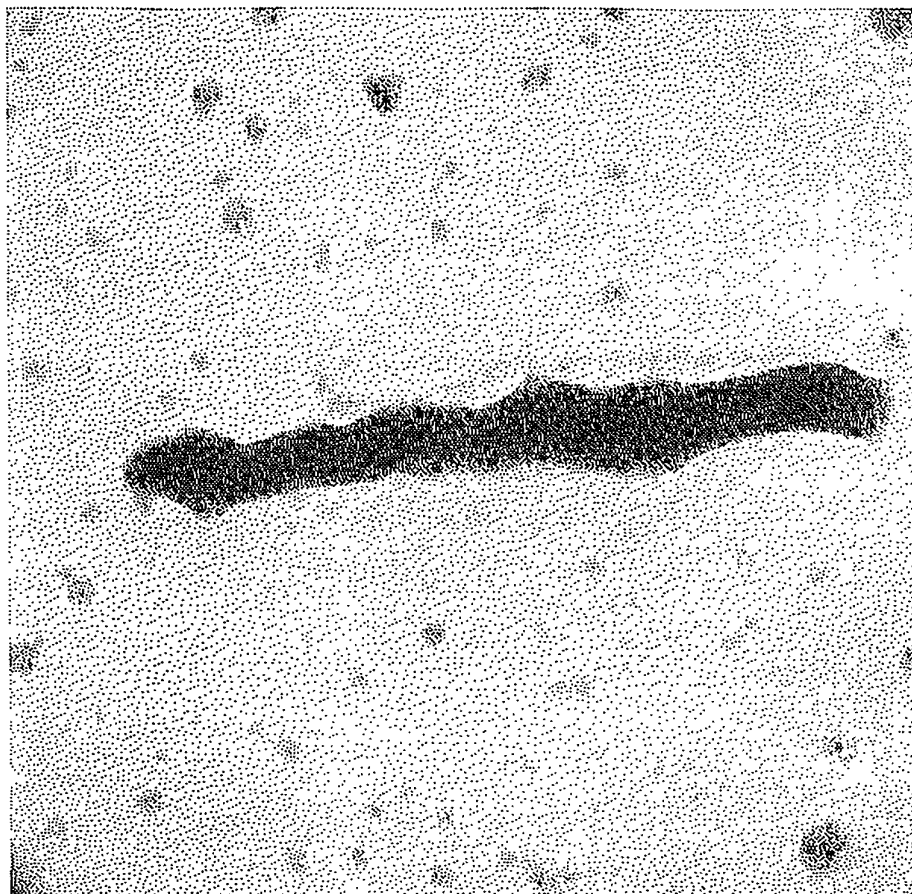


FIGURE 6